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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Collapsible Dispensing Tubes

We, AMERICAN CAN COMPANY, a Corporation organised and existing under the laws of the State of New Jersey, United States of America, of 100 Park Avenue, New York, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to collapsible tubes such as tubes used for dispensing pastes, creams and the like and, more particularly to tubes formed from a laminated material.

Collapsible dispensing tubes made of both metallic and plastics materials are well known. The metal tubes are impermeable to moisture and volatile oils and, therefore, are widely used for packaging pharmaceutical products, cosmetics, toiletries and the like which contain these ingredients. They are also impervious to oxygen and hence, capable of protecting a container product against deterioration from this source.

Metal tubes such as are made from lead or aluminium are normally seamless and are costly to produce due to the high material cost and the manner in which the tubes must be made. This includes individual printing of each tube with suitable decorative material after it has been formed. Moreover, the chemical nature of the metals used often makes necessary the extra step of completely coating the interior of the tube with a protective layer so as to preclude attack and corrosion of the metal by alkaline or acid contents resulting in contamination of the contents by the reaction products.

On the other hand, plastics tubes are relatively inert and are better suited for many products that attack metal. Unfortunately, the thin body wall of the plastics generally used is apt to be permeable, in varying degrees, to moisture, certain essential oils, perfumes, flavourings, and other volatile ingredients. Consequently, there is often a considerable loss of the volatile oils and moisture during storage, resulting in some deterioration or dehydration of contained products such as toothpaste, shaving cream, medicinal ointments, and the like. Moreover, many plastics favoured for plastics tube manufacture are oxygen-permeable and are inferior to metal tubes in this respect.

Even where permeability is not a factor, plastics tubes have a further serious disadvantage in that printing or decorative material applied to the surface of the plastics will often not adhere readily, unless the plastics surface is first treated in some manner. This is an additional expense contributing to the cost of these tubes.

It is therefore an object of the invention to provide a collapsible dispensing tube which will overcome the problems hereinbefore discussed.

According to the invention there is provided a container wherein a laminated collapsible tubular body has a thermoplastic headpiece fused thereto, and the body comprises a first layer of fluid-impervious metal foil; a second layer of a thermoplastic or other bonding material adhering to the inside of the foil layer; and a third layer of a different thermoplastic material different to the material of the second layer and adhering to the second layer and fused to the headpiece.

The first thermoplastic layer may comprise a copolymer of ethylene and either an acrylic acid or an acrylic acid ester. The second thermoplastic layer may be a polyolefin.

The following is a description, by way of example, of certain constructions in accordance with the invention, reference being made to the accompanying drawings, in which:—

[*Price 4*

Price

Fig. 1 is a side elevation of a collapsible dispensing tube with a portion of the body wall broken away;

Fig. 2 is an enlarged partial sectional view showing the fused joint between the tube body and the headpiece;

Figs. 3—7 are fragmentary enlarged sectional views of the body wall illustrating various laminated structures.

As a preferred embodiment of the invention, Fig. 1 shows a container in the form of a collapsible tube, generally designated 10, comprising a tubular body 12 having a longitudinally extending side seam and which ordinarily in use is closed at one end, after filling the container, by heat sealing or other techniques as at 14. The tubular body 12 mounts at its opposite end a plastics headpiece 16 which is usually shaped to provide a threaded neck so that a cap 18 may be secured thereto when the tube 10 is filled with product 20. However, other headpiece configurations may be employed without departing from the scope of the invention.

The headpiece 16 has a portion 29 (Fig. 2) which laps down inside the tube and is fused to the body by a suitable procedure such as described in Patent 687320.

The tubular body 12 as shown in Fig. 2 comprises a plurality of layers. Particular applications may permit a reduction in the number of layers, while other aplpications may render desirable the use of more layers in the laminate. In Fig. 2 the body 12 comprises a fluid-impervious metal foil layer 22 which provides the barrier protection against oxygen absorption from the atmosphere and essential oil permeation outwardly through the tube body 12. The thickness of this metallic foil is sufficient to impart the requisite barrier properties and yet is maintained relatively thin in the interests of cost and pliability of the container during use. Aluminium foil has been found particularly suitable for this use, although other metallic foils such as steel or tin plate may also be utilised. In general, when aluminium foil is used, a thickness of approximately 0.0007 inch has been found to be satisfactory to facilitate handling and assuring that no pin holes will be present in the material.

On the inside of the foil layer 22 is a bonding layer 24 of a thermoplastic or other bonding material which adheres strongly to the metal and will effectively bond a next interior layer 26 in the laminate structure and will prevent delamination of the layers due to product attack or abusive handling. The next interior layer in the laminate is material which does not readily adhere to metals, such as polyolefins and other resins. A special synthetic resin is preferred for the bonding layer 24, such as comprises, a copolymer of ethylene and either an acrylic acid or an acrylic acid ester hereinafter referred to as copolymer. The acrylic acids useful are acrylic acid, methacrylic acid and ethacrylic acid. The acrylic acid esters include: methyl and ethyl acrylate; methyl and ethyl methacrylate; and methyl and ethyl ethacrylate. All of these unsaturated acids and their esters conform to the general formula $CH_2=CR—COOR^1$ where R and R^1 are hydrogen or lower alkyl, particularly methyl or ethyl, radicals. This resin has been found to be especially effective in bonding polyolefins to aluminium.

The interior layer 26 forming the inner surface 25 of the body 12 is of a different thermoplastic material which adheres to the copolymer layer 24 and so is bonded to the foil layer 22 by means of the copolymer layer 24. This thermoplastic layer 26 is preferably a polyolefin, generally taking the form of a low density polyethylene. When the polyethylene layer 26 is approximately 0.002 inch thick, it is preferred that the copolymer layer 24 have a similar thickness. When the copolymer is somewhat expensive, it is readily apparent that the use of polyethylene will also reduce the overall cost of materials.

The preference for the inner layer 26 in the laminate being polyethylene is due to the problems encountered in joining the headpiece 16 to the tube body 12. A number of factors are thought to be responsible for this difficulty.

The first of these is due to the relatively limited amount of heat available during the molding of the headpiece for effecting the fused connection between the headpiece and the body 12. It is has been found that polyethylene does not bond readily to the types of copolymer contemplated for the tube constructions of this invention unless substantial heat is available for the fusion. Improper bonding of the headpiece 16 to the body 12 would, of course, result in leakage or possibly even separation of the headpiece 16 from the body 12.

It is thought that the necessity for large quantities of heat when bonding polyethylene to the copolymer is due to oxidation of the copolymer under standard atmospheric conditions. Thus, an oxidized layer of material on the surface of the copolymer would have to be melted before fusion could occur between the molten thermoplastic headpiece and a copolymer surfaced tube body.

By utilizing a thermoplastic less susceptible to oxidation, such as a polyolefin and especially polyethylene, as the inner surface of the body 12 to which the substantial portion of the fused connection depends, the problems encountered in fusing the headpiece 16 to the body 12 have largely been obviated.

The problem does not arise in the initial laminating operation, where there is little delay in covering the copolymer layer with polyolefin and sufficient heat is available, to give satisfactory fusion and adhesion.

Although a similar problem does exist in forming a side seam in a tube body when a

polyolefin-copolymer fusion is needed, this has not been found to be a serious matter. Little difficulty has been encountered in forming a polyolefin-copolymer bond in the side seam due to the fact that the required heat can be made available by the sealing tools used in formation of the side seam.

In fusing the headpiece 16 to the body 12 the headpiece 16 is provided with a cylindrical skirt portion 29 and a peripheral inwardly curved portion 31 which are fused to the tube body 12 at its upper marginal inner surface 32 and upper edge 33 forming a head joint 35. The continuous peripheral and vertical fused areas of the joint 35 results in a strong attachment of the headpiece 16 to the tube body 12 with a high resistance to separation by either axial, radial, or twisting forces or combinations thereof. Preferably, the upper end 37 of the tube body 12 is turned in slightly and recessed into the headpiece 16 with the edge 33 of the body welded to the material of the head so that the outer surface of the joint 35 is a smooth substantially uninterrupted surface.

In the remainder of the body laminate in this embodiment, a fibre layer 38 is bonded to the exterior of the foil layer 22 by means of another bonding layer 24*a*. This outer bonding layer 24*a* may be the same copolymer as inner layer 24. However, the bonding material utilized may sometimes differ from that used in bonding metal to a polyolefin, since the bonding characteristics of fibre to metal are different from that of metal to polyolefin. Many forms of paper may be used for this fibre layer 38. However it has been found that wet strength glassine having a thickness of from 0.001 to 0.0045 inch is adequate. The thin paper serves both to increase the strength of the laminate and also to provide a background for tube decoration.

Overlying the fibre layer 38 and forming the exterior surface of the tube is a substantially transparent layer of clear resin 40. This resin layer 40 serves to protect the tube body 12 from abuse during handling and also to effectively seal the laminate collapsible tube 10 from absorbing any liquids that may come in contact with its exterior surface. Although this clear resin may be any of a number that are suitable for and compatible with both the laminate structure and its ultimate use, it is preferred that a polyolefin such as clear polyethylene having a thickness of at least 0.001 inch be used. It is thus readily apparent that any decoration or indicia (not shown) that may be placed on the surface of the fibre layer 38 will be protected and be visible through the clear polyethylene 40. This decoration is preferably printed in the flat before the laminate material is formed into the tubular body 10, for versatility and economy.

It will be understood from the above description and Fig. 2 that a substantial fusion zone is created between the readily fusible materials of the headpiece 16 and inner surface 32 of inner polyolefin layer 25, in the vertical area of joint 35, as well as with the end surfaces of layers 25 and 40, in the peripheral area of the joint. Throughout this entire joint, the actual contact between the headpiece 16 and the not-so-readily fusible copolymer layers 24 and 24*a* is slight, thereby minimizing any derogation of the desired fusion which otherwise could result due to the tendency of the copolymer to oxidize.

In a modified form of the invention, as shown in Fig. 3, the three interior layers 22, 24, 26 of the laminate are similar to these hereinbefore described and perform similar functions. However, instead of a paper layer 38 being bonded to the foil layer 22 by means of the outer bonding 24*a*, a layer of substantially opaque thermoplastic 42 is used as the base upon which an indicia is placed. It is preferable that this opaque thermoplastic layer 42 be a polyolefin such as polyethylene having a thickness of from 0.001 to 0.004 inch. In this instance, it is preferred that the outer bonding layer 24*a* is of the same copolymer material as inner bonding layer 24.

Indicia or decoration 44 is applied to the opaque thermoplastic layer 42 by means known to those skilled in the art. Generally, these indicia 44 are in the form of an ink pattern and are applied while the laminate is still in the flat before the initial step of forming the tube. Some prior surface treatment of the opaque polyolefin layer 42 is ordinarily required to improve the receptivity of the decoration 44. The decoration is then covered with a thin transparent resin layer 40, such as clear polyethylene of the order of 0.001 inch thic as in the preceding embodiment, thus sealing the indicia 44 into the tube wall and protecting the indicia 44 from marring or scratching in subsequent handling while the tubes are being filled, shipped, etc.

In a further modification of the invention, as shown in Fig. 4, the inner layers 22, 24 and 26 are as described hereinbefore. In this construction an opaque thermoplastic layer 42 similar to that shown and described in Fig. 3 is also utilized, with the outer bonding layer 24*a*. Upon this layer 42 is imprinted the indicia 44, after suitable treatment of the layer 42 to improve receptivity. However, in this modification no coating is placed over the indicia but the indicia form the exterior surface of the tube body.

In the tube construction shown in Fig. 5, the indicia or decoration 44 are applied directly to the intermediate foil layer 22. The outer bonding layer 24*a* of the preceding embodiment is omitted. The interior layers 24 and 26 are as described hereinbefore. Since the indicia 44 are placed directly on the metal foil 22, no prior surface treatment to increase ink adherence is required as is the case where the

indicia 44 are applied directly to a thermoplastic surface. Thus, since the bonding layer 24*a* is omitted and no surface treatment of a thermoplastic layer is necessary, the processing costs are substantially reduced. This type of decoration is, however, limited due to different surface requirements for different indicia. In order to protect the indicia 44 they are sealed into the tube well beneath an outer layer of clear resin 40 as in the embodiment shown in Fig. 3. This clear resin 40, in this embodiment preferably polyethylene, has a thickness of approximately 0.003 inch to provide adequate protection for the indicia 4 and add strength to the body 12. The polyethylene adheres to the printed foil well enough for this exterior protection for a cheaper product, where a strong bond is not necessary.

In the construction shown in Fig. 6, the bonding layer 24 between the foil 22 and the inside thermoplastic layer 26 is similar to Fig. 5, with variations in thickness of the layers 24 and 26 to compensate for the added thickness of the outer bonding layer 24*a*. With this construction, the inner bonding layer 24 is approximately 0.001 inch while the thermoplastic layer 26 is approximately 0.003 inch.

In order to further minimize material usage in this construction and thus reduce costs, the outer bonding layer 24*a* is also approximately 0.001 inch thick and is preferably opaque as is the case with the aforementioned copolymer. The indicia 44 are applied directly upon the opaque bonding layer 24*a* and then covered with the clear or transparent resin 40, which has a thickness of approx. 0.002 inch. If it is desired that the background for the indicia 44 be of a metallic nature, then the bonding layer 24*a* upon which the indicia 44 are imprinted is transparent, thus providing the metallic foil 22 as the background.

Another alternative body laminate, as shown in Fig. 7, comprises an intermediate foil layer 22, as hereinbefore described, with bonding layers 24, 24*a* on either side. Forming the inner surface of the laminate is a thermoplastic layer 26, which is bonded to the foil layer 22 by means of the copolymer layer 24. This thermoplastic layer 26 is preferably a polyolefin, generally taking the form of a low density polyethylene. It is preferred that the combined thickness of the layers 24, 26 be approximately 0.004 inch.

Bonded to the outer copolymer layer 24*a* is a layer of fibre 38 over which is bonded a layer of opaque thermoplastic 42, preferably polyethylene. As was discussed before, the surface of the opaque thermoplastic layer 42 is treated by means well known to those skilled in the art to make it receptive for printing. Thus indicia 44 are placed upon the opaque layer 42. The background afforded the indicia 44 is thus quite dense due to the multiple fibre and opaque thermoplastic layers 38, 42. Overlying the indicia 44 and forming the external surface of the tube is a substantially transparent layer of clear resin 40, a polyolefin, such as polyethylene, being preferred, which is thick enough to afford protection of the indicia 44 during any handling of the tube body.

WHAT WE CLAIM IS:—

1. A container wherein a laminated collapsible tubular body has a thermoplastic headpiece fused thereto, and the body comprises:

a first layer of fluid-impervious metal foil;

a second layer of a thermoplastic or other bonding material adhering to the inside of the foil layer;

and a third layer of a different thermoplastic material different to the material of the second layer and adhering to the second layer and fused to the headpiece.

2. A container according to claim 1 wherein the second layer comprises a copolymer of ethylene and either an acrylic acid or an acylic acid ester.

3. A container according to claim 2 wherein the second layer comprises a copolymer of ethylene and acrylic acid.

4. A container according to claim 2 wherein the second layer comprises a copolymer of ethylene and ethyl acrylate.

5. A container according to any of claims 1 to 4 wherein the third layer is a polyolefin.

6. A container according to any of claims 1 to 5 wherein the third layer is polyethylene.

7. A container according to any of claims 1 to 6 wherein the third layer and the headpiece are of the same material.

8. A container according to any of claims 1 to 7 wherein the headpiece is injection moulded to the third layer.

9. A container according to any of claims 1 to 8 wherein the third layer is the innermost layer of the tubular body.

10. A container according to any of claims 1 to 9 wherein the third layer is integrally fused at a marginal end to the headpiece.

11. A container according to any of claims 1 to 10 wherein the body comprises further layering of material to the outside of the foil layer.

12. A container according to claim 11 wherin the body comprises a fourth layer of a thermoplastic or other bonding material adhering to the outside of the foil layer, and further layering adhering to this fourth layer.

13. A container according to claim 12 wherein the body comprises a fifth layer of a thermoplastic material outside the fourth layer.

14. A container according to claim 13 wherein a fibre layer is interposed between the fourth and fifth layers.

15. A container according to any of claims 12 to 14 wherein the fourth and second layers are of the same material.

16. A container substantially as any one of

the embodiments hereinbefore described with reference to or as illustrated in the accompanying drawings.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

FIG. 1

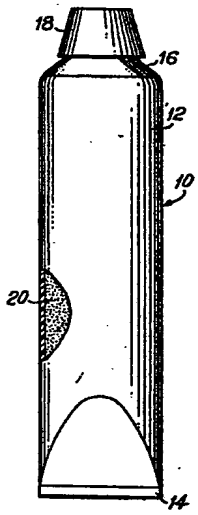

FIG. 2

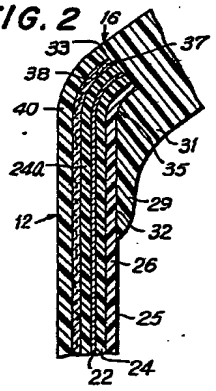

FIG. 3

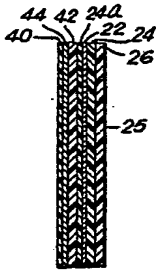

FIG. 4

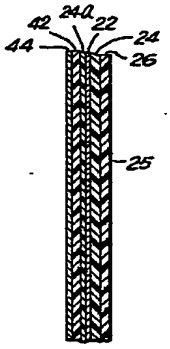

FIG. 5

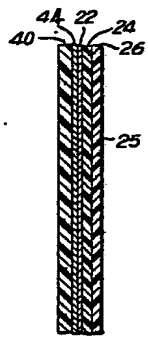

FIG. 6

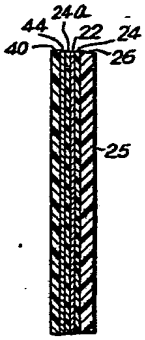

FIG. 7